LUBRICATION

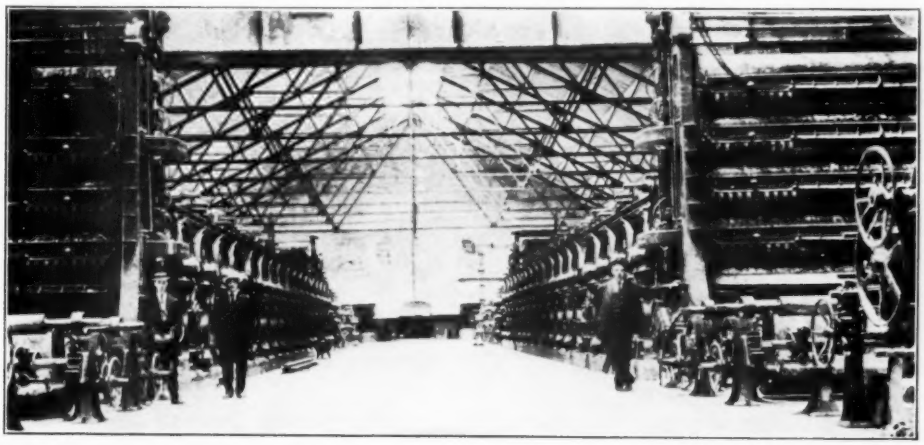
A Technical Publication Devoted to the Selection and Use of Lubricants

Published Monthly by

The Texas Company, 17 Battery Place, New York City

Vol. X November, 1924 No. 11

Change of Address: In reporting change of address kindly give both old and new addresses.



Courtesy of The Pusey & Jones Co.

Fig. 1.—Machine Room in a Modern Newsprint Paper Mill taken from the dry end. (Note comparative height of calender stacks, next to which the men in the foreground are standing.)

Lubrication in the Paper Industry

PART II

Conversion of Pulp to Paper

AVERAGE lubrication costs per ton of finished paper were given in LUBRICATION for October 1924. These figures show that only a small part of the total expenditure for lubricants is paid out in the pulp making processes. The manufacturer of pulp averages for lubricants about $.03 per ton finished paper, while in the machine room and for paper stock preparation and power the combined cost averages about $.12 per ton in newsprint paper; and, about $.32 per ton for all other papers, while paper board due to its comparative weight, averages as low as $.09 per ton finished product.

Nor are you to consider your costs satisfactory if they are close to these averages, but rather the actual *low* costs should be considered an attainable goal. These low costs are $.06 per ton for newsprint paper, and $.11 per ton for other papers except paper board which is sometimes brought down to $.05 per ton finished product.

Concrete suggestions of how to go about reducing your lubrication costs were presented

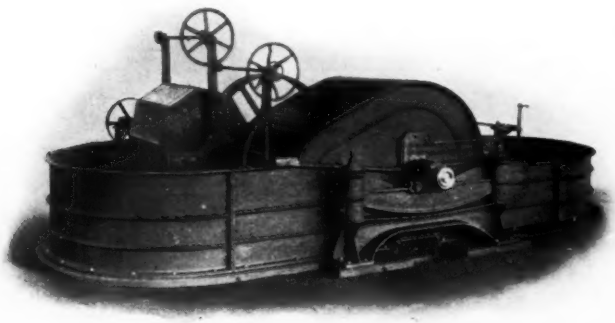
and the various types of pulpwood and pulp making machinery and their lubrication problems were described and discussed.

In this issue we take up the machinery used in paper stock preparation and the conversion of stock to paper.

PAPER STOCK PREPARATION

Beater Room

Pulp, prepared as described in the previous issue of LUBRICATION, is not a form of paper but merely one of the constituent raw materials of which there are several others, such as clay "fillers," size, alum, talc, coloring materials, etc. The "fillers" are necessary to impart a certain degree of opacity to the otherwise transparent cellulose fibres which make up the structure of paper.



Courtesy of Downingtown Mfg. Co.

Fig. 2.—Holland Type Beater with Cylinder Washer.

With the exception of special cases where the pulp laps are dried or frozen, the first of the more common processes to which the above constituent raw materials is subjected is the beater.

A function of the Beater, or Hollander as it is sometimes called, is to thoroughly mix the pulp with other paper stock ingredients and to beat apart or finely divide the pulp fibres. The beaters also assist in cutting the fibres to the proper length. While it is true that the longer the fibres the stronger the paper, the paper machine cannot interlace and drain paper stock quickly enough if the fibres are too long.

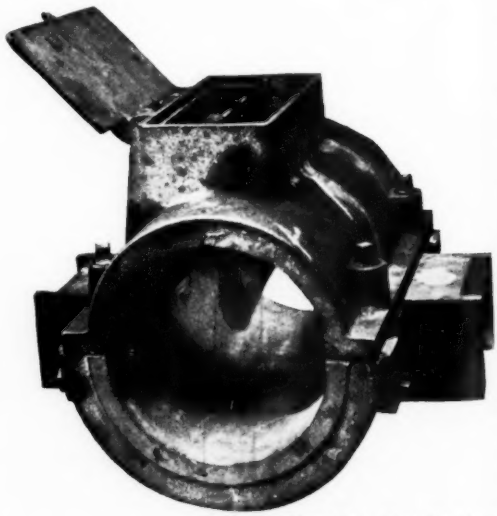
If the pulp to be sent to the beaters is in the form of "laps," especially if dried or frozen it is usually broken up in a shredder, before going to the beaters.

PULP SHREDDERS

The most common shredder consists of a casing with fixed knives within which there is a rotor also bearing knives and operating at about 700 R. P. M. in the presence of water. Another type is not unlike the rag cutter described in the previous issue. The bearings are usually automatically lubricated in the newer designs, i. e. ring or collar oiled. Even when plain bearings are involved they are usually protected from water.

Lubrication

If the bearings are automatically oiled and close fitting an oil of approximately 300 seconds viscosity* should be employed. If automatically lubricated but worn or loose, or if the bearings are plain and hand oiled a viscosity of 450 to 500 seconds is preferable. A medium consistency grease should be used for grease cups or when grease is applied by hand to an open bearing. In the latter case, however, and also when plain bearings are hand oiled great economy can be effected by installing wick feed or wick and pad oilers. Not only do they eliminate waste and messy conditions but also they are, when properly adjusted, entirely automatic for at least the weekly period between shutdowns. Gears should be given a hot application of an adhesive, viscous, straight mineral lubricant of 1000 seconds viscosity Saybolt at 210 degrees F.



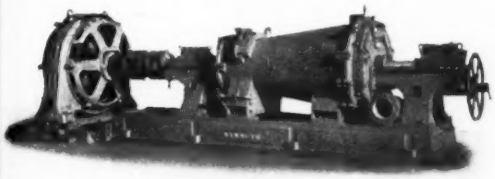
Courtesy of The Noble & Wood Machine Co.

Fig. 3.—Beater bearing of the plain type equipped with wick and pad, and oil tray situated above lower end of wick which provides syphonic as well as capillary oil feed.

*In this article all viscosities unless otherwise noted are Seconds by Saybolt Universal Viscosimeter at 100 deg. F.

BEATING ENGINES

The beater is an oval tub about 25 feet long by 11 feet wide, containing a central partition called a midfeather, parallel to the



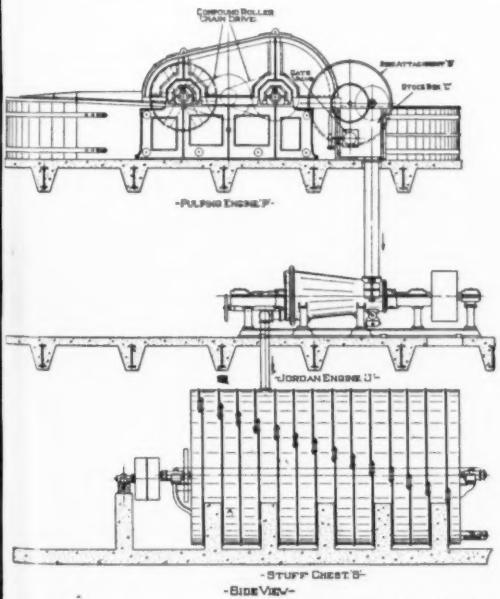
Courtesy of The Noble & Wood Machine Co.

Fig. 4.—Modern Jordan and individual electric drive.

sides but stopping short of the ends by about 3 feet. On one side of the tub, filling the space between the midfeather and the tub wall is the cylindrical beater roll.

This roll is very heavy and is equipped with knife-like ribs set longitudinally in its surface.

The roll revolves directly over the concave bed plate with a similar set of parallel blades or ribs on its opposing surface. This action separates the fibres of the pulp and prepares it for the later processes. The roll can be raised or lowered from the bed plate according to the fineness of the fibre required. These steel blades are dull enough not to *cut* the fibre, their function being to beat apart



Courtesy of The Noble & Wood Machine Co.

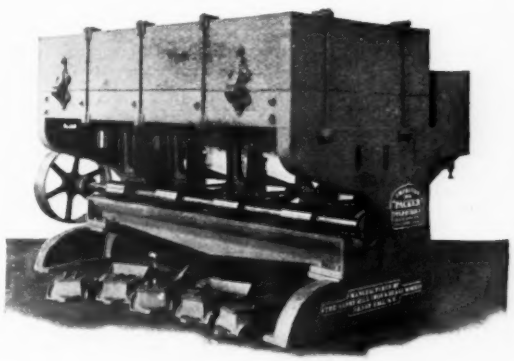
Fig. 5—Typical Stock Chest installation.

bundles of fibres when the paper stuff passes between the roll and the bed plate.

Lubrication

Beater bearings are subjected to heavy pressures due both to the weight of the roll which may be several tons and to tight belts. Except in more recent designs provided with some sort of shock absorbing device, beater bearings are usually provided with plain bottom half bearings only, in order to accommodate the lifting action caused by masses of pulp passing between the roll and bed plate.

The beater bearing is difficult to properly lubricate due to the pressure resulting from lifting up and suddenly dropping back and also because when this takes place water and pulp get into the bearing.



Courtesy of The Sandy Hill Iron & Brass Works.

Fig. 6.—A diaphragm pulp screen strains the stock before it flows onto the paper machine.

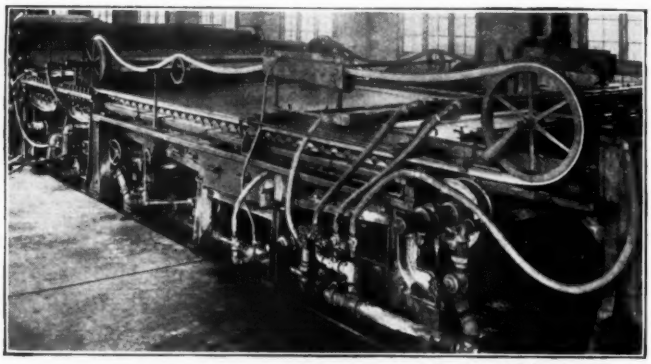
If the bearings are close fitting and automatically lubricated with wick feed, ring or chain oilers an oil of 500 seconds viscosity should be used. If the bearings are worn or loose and either automatically or hand oiled a higher viscosity, at least 70 seconds at 210 degrees F. is necessary.

In order to cut down on the number of different grades of lubricants necessary to stock in your oil house it is advisable to use under the *latter* conditions, the steam cylinder oil in use in your power plant or on your dryers. In this event you should make certain that the cylinder oil is not too heavy for use on wick feed or ring oilers.

When grease is applied by hand either to open upper half bearings or on bearings provided with grease pockets, a high melting point special grease should be used. However, as mentioned under Shredders above, and, as outlined in October LUBRICATION the installation of wick and pad oilers will pay unexpected dividends in saving of bearing metal, shutdowns, and elimination of oil waste.

REFINERS

The pulp or paper stock coming from the beaters is stored in the "Jordan Chest" where revolving blades keep it agitated and prevent settling. It is the practice in some mills, to add the fillers and sizing in the Jordan Chest rather than in the beaters. The paper stock



Courtesy of Beloit Iron Works.

Fig. 7.—Close-up of Wet End of Fourdrinier Machine (The flat shiny surface on the machine is the "wire" with its coating of wet paper web.)
(Note series of 35 table rolls supporting the wire.)

is next pumped as needed to the Jordan engines, Kollergangs and other refining engines. The most common in America is the Jordan, which consists of two concentric cones equipped longitudinally with knives on their contact surfaces, the inner cone or "plug" revolving against the outer at such distance as may be required to give the proper character to the stock. This distance is adjusted by means of a movable thrust bearing at the large end of the outer shell.

The paper stock by this operation secures the last finishing touch before it goes to the paper machine. Small bundles of fibres escaping the beating action in the beaters are finely divided and thoroughly mixed with water to furnish a uniform stock. The Jordan finishes the job of hydration of the cellulose, i. e.; the fibres finally absorbing the largest possible amount of water.

Lubrication

The thrust bearing is very difficult to properly lubricate and several most recent designs provide anti-friction ball or roller bearings with oil tight housings permitting the use of an oil of viscosity as low as 200 seconds. However, if the bearing case is not oil tight a liquid grease should be used.

When the bearings are close fitting and ring oiled or plain with wick feed oilers, an oil from 300 to 500 seconds should be used, but if worn or loose, or hand oiled a viscosity of at least 70 seconds at 210 degrees F. is required. If not too heavy for ring or wick oilers the steam cylinder oil in use elsewhere in the mill will be very satisfactory, for worn bearings.

For grease packed bearings a special high melting point grease is required, or wool yarn with a grease of the cylinder stock type; though again it would be more desirable to adopt wick feed oilers as described under Beaters.

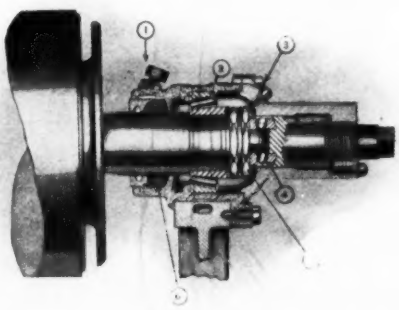
Be sure that the thrust bearing actually receives the lubricant intended for it. Often the oil ducts leading to it are too small or are clogged.

The only problem in the lubrication of the Kollergang is the large gears which operate the grindstones. These gears should be treated with a hot application of an exceedingly adhesive and viscous straight mineral lubricant as described in October LUBRICATION under "Gears, Wire Rope and Chains."

The bearings of Kollergangs and other refining engines should be lubricated, if close fitting and automatically oiled, with an oil of 300 seconds viscosity. If worn or loose however, or hand oiled, a viscosity of 500 seconds may be required. If grease lubricated a medium consistency should be used.

STOCK CHEST AGITATORS

A typical stock chest installation showing a line up of beater and Jordan is illustrated in Figure 5. These chests are sometimes 30 feet deep and 20 feet in diameter and besides being designed for storage of paper stock their purpose is to keep the stock so agitated (particularly in the "machine chest" after treatment in the Jordan) that it is in a uniform state of mixture and suspension.



Courtesy of Beloit Iron Works.

Fig. 8.—Recent design of Breast Roll roller bearing, 1, Grease for water packing, 2, Roller Bearing assembly, 3, Change grease here every 60 days, 4, Thrust bearing, 6, Wick packing impregnated with grease and plumbago.

Lubrication

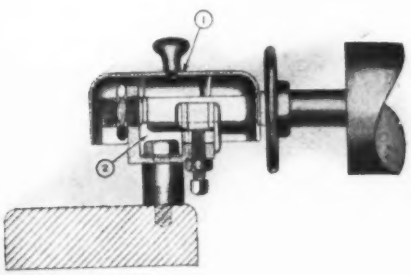
Agitator bearings do not suffer heavy duty and are usually of the plain type intended for hand application of the lubricant. Wick oilers if installed will be more economical beside permitting use of oil of 300 seconds viscosity if the bearings are close fitting, otherwise an oil of 500 seconds should be used, or a grease of medium consistency. The gears should be lubricated with a viscous and adhesive lubricant as described under Refiners.

PLUNGER STOCK PUMPS

The pump is the heart of the paper mill. If the pump breaks down, the mill stops. Every movement of the pulp through its various stages from its first preparation to the flow box at the wet end of the paper machine is made by means of a pump. Fan or centrifugal pumps were discussed under pulp making—the geared plunger type however, is largely used in the paper mill.

Lubrication

The bearings are usually plain and provided with sight feed bottle oilers. Hand oiled crossheads and guides should be adapted



Courtesy of Beloit Iron Works.

Fig. 9.—Modern Table Roll Ball bearing which eliminates troubles from water wash. 1, Cover to exclude water and grit; 2, Oil bath in leakproof housing.

for wick feed when possible. When the bearings are close fitting use an oil of viscosity of approximately 300 seconds otherwise an oil of 500 seconds should be applied. Grease cups should be filled with a medium bodied grease but when possible the installation of oilers, is desirable.

CONVERSION OF STOCK TO PAPER

We have now come to the most interesting stage in the metamorphosis of a log of wood to finished paper—the paper machine. Liquid paper stock (99% water) is pumped in one end of this huge machine and emerges dry and polished and neatly wound on reels as finished paper almost a block away from the commencement of the process, which is automatic and continuous. Of all the machinery in this and perhaps all industries, the paper machine is the most costly and complex. The larger machines weigh up to two million pounds and may cost five hundred thousand dollars. It isn't a sluggard, either, as some machines reel up a 164 inch sheet at the rate of 1000 feet per minute; it takes only 15 seconds for the wet paper stock to travel the 250 feet from flow box to winding reel.

As the pulp flows onto the wire 99% water and reaches the winder in a quarter of a minute as "air-dry" paper, it is obvious that considerable heat is required to do the work of removing the water. It is true that draining through the wire plus the action of the suction boxes, suction couch and press (or wringer) rolls removes 40% water but the balance must be driven from the mushy paper by heat in the drier rolls and when we consider that roughly a ton of coal or its equivalent is required in the manufacture of a ton of paper it should be remembered that the greater part of the fuel is used not for power, but for removal of moisture.

Machine Room

Paper stock is first pumped from the machine stock chest to the "mixing box" where water is added until the pulp mixture is about 99% water to 1% fibre—it is here that the weight of the paper is established. A Fan pump next gives the dilute pulp a thorough mixing whence it proceeds directly to the flow or head box of the paper machine or to it by way of a paper machine pulp screen, to remove any last bits of coarse matter which may have escaped the Jordans.

DIAPHRAGM AND ROTARY SCREENS

Paper machine pulp screens or strainers are exactly similar to the pulp screens previously described except that the screening devices are finer than those used for pulp manufacture. The diaphragm flat type screen is most commonly used in the machine room though the rotary screen is often specified in recent installations.

Lubrication

If the bearings are close fitting and automatically lubricated an oil of 300 seconds viscosity should be used, while for other conditions an oil of 500 seconds is required—if grease lubricated a medium consistency product should be used. Cams and eccentrics of the diaphragm screen require an oil of about

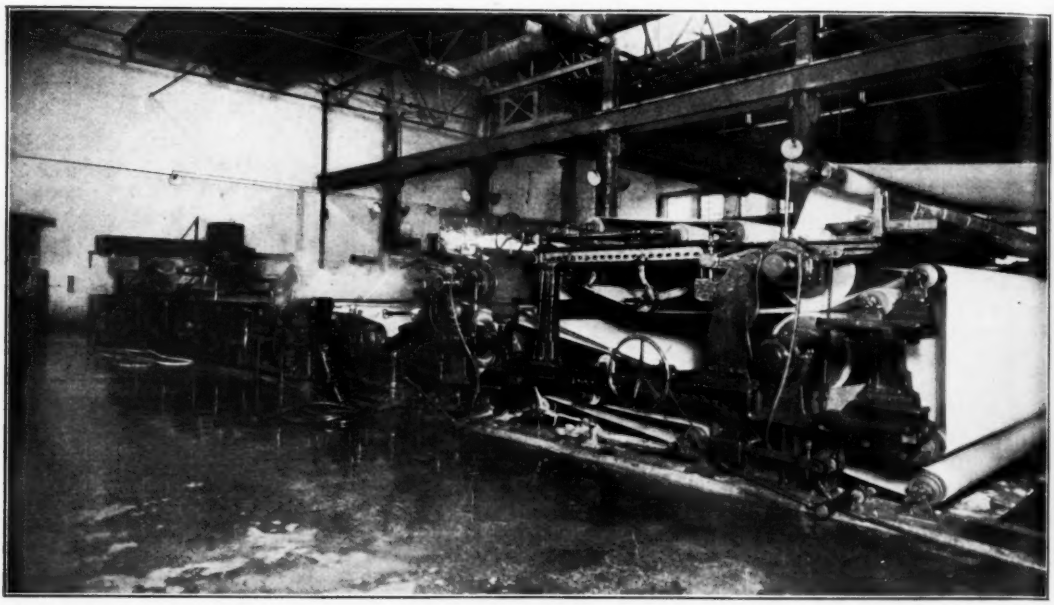


Fig. 10.—Imagine you are standing opposite the middle of this huge Fourdrinier paper machine. Above is shown the "wet end." On your extreme left is the diaphragm screen and in succession coming towards you is the "wire" (located by the spray), then suction couch roll and first and second pairs of press rolls.

70 seconds viscosity Saybolt at 210 Deg. F. The gears and sprockets on the rotary screen require a hot application of an adhesive straight mineral lubricant of 1000 seconds viscosity Saybolt at 210 Deg. F.

THE PAPER MACHINE

There are two very different types: first, the cylinder or vat machines used for paper board and tissues; and second, the Fourdrinier Machine, sometimes modified to the Harper Fourdrinier, and the Yankee Machine or the Flying Dutchman.

The Straight Fourdrinier, however, is the most commonly used for all types of papers except board and some tissues.

Since the modified Fourdrinier machines offer no lubrication problems not met with in the straight Fourdriniers, and as they differ from it only in detail they will be considered hereafter under the one heading.

FOURDRINIER MACHINE—WET END

The Fourdrinier "wire," onto which the fluid paper stock flows from the head box through the apron trough, is an endless belt of fine copper or bronze wire mesh screen rapidly moving away from the direction of flow.

Breast and Table Rolls:

The wire is supported on a series of parallel brass tube rolls which form a flat table surface for the first stage in the actual manufacture of paper. The first of these rolls is called the breast roll. It is a function of the wire to drain off as much water as possible and this escapes between the table rolls and cataracts into a "save-all" or a trough beneath the machine.

Save-All:

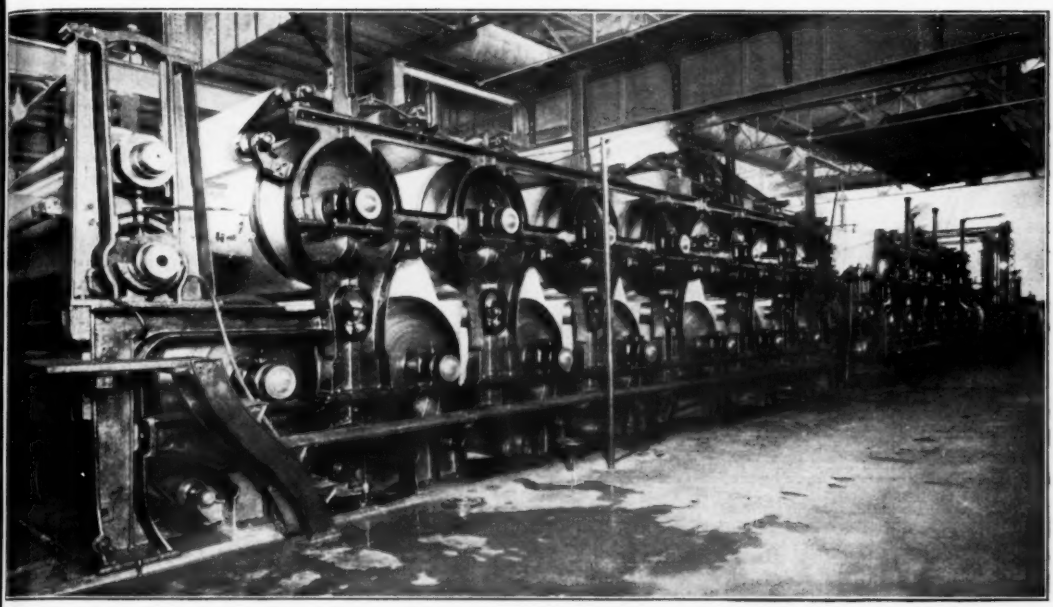
The paper machine save-all is a series of trays that catch the water and pulp which drains through the wire. Another type of save-all, located in the basement for recovering fibre from the effluent, is not unlike the pulp thickener previously described.

Wire Guide and Return Rolls:

After leaving the table rolls the wire travels over suction boxes in which a sufficient vacuum is maintained to assist in removing water from the fast forming paper as it rushes along with the "wire." The wire next meets and travels over the guide roll which keeps it in proper alignment before passing over the *lower* "couch" roll whence it is again led back to the breast roll, over "return wire rolls" or carrying and stretch rolls which are directly underneath the table rolls.

Deckles:

While the paper is thus in formation it is prevented from spreading or flowing off the edges of the wire by the deckle straps which are endless rubber belts, the lower strand of which is supported and carried along by the wire until after reaching the dandy roll when it is picked up and returned to starting



Courtesy of The Champion Coated Paper Co.

Fig. 10A.—This is the "dry end" of the machine—note third set of press rolls in front of you, followed by the long series of revolving steam heated yer rolls, and 125 feet away at your extreme right hand is the high calender stack (shown in Fig. 16) followed by the winding reel where the paper is eatly wound up in rolls.
The liquid pulp is converted to dry paper in 30 seconds, travelling in this time a total distance of 250 feet.

oint as an upper strand by the flanged deckle pulleys.

Dandy Rolls:

Between the last table roll and the guide roll s usually a light weight roll called the "dandy." This has nothing to do with the wire and rests ightly on *top* of the fast forming paper tending o smooth the surface of the sheet. As the aper is still capable of being moulded at his point, the dandy roll is often used to ntroduce a water mark, by means of raised ettering on surface of the rolls.

Shaking Frames:

To assist in interlacing the fibres during the draining process on the wire, most machines with exception of those of latest type for newsprint are designed by means of a shake frame to give a lateral shaking motion to the table rolls and wire.

Lubrication

Except in newest designs where anti-friction bearings are used, all bearings of the above described parts of the paper machine are more or less water splashed which renders proper lubrication difficult, and requiring a lubricant specially compounded to emulsify with water and form a lubricating film capable of remaining in place in presence of water.

If the bearings are close fitting and equipped with automatic oiling devices, the viscosity should be from 650 to 700 seconds, while if worn or loose and lubricated with automatic oiling devices or hand oiled it is preferable to use the cylinder oil as carried for the power plant. This will satisfactorily meet the water conditions unless it is a "*mineral*" cylinder oil, as used when the exhaust steam must be free from oil.

In case the cylinder oil in use in the power plant is used for lubrication of worn or loose bearings lubricated by *ring* or *wick oilers*, particular pains should be taken to make certain that it is not too heavy or of too high a viscosity to work properly—if so it will be necessary to specify a compounded oil of lower viscosity.

These bearings are commonly of the open half bearing type lubricated by hand application of grease or a piece of oil saturated felt. Table roll bearings are often fairly well lubricated by applying to the tops of the journals one long strip of oil soaked felt.

If grease is insisted upon it should be of medium consistency and capable of emulsifying with water to form a lubricating film which will not be washed away. It is much preferable when possible, to install wick oilers even on table roll bearings on which special adaptation of *individual* wick oilers is usually impossible. Unreliable hand application of oil and grease can be efficiently and inexpensively eliminated by means of the simple reservoir wick feed device, as described below.

Particular attention should be paid to

the lubrication of the table rolls, for in spite of the fact that they usually remain fairly cool due to the water washing and because there are no great bearing pressures, they are often a heavy contributing cause to high production cost whenever they have a tendency to drag or what is much worse stick due to improper bearing lubrication. A moment's thought shows the consequences —a dragging table roll bearing causes flat

Fig. 11.—Diagram of the first two of a battery of wick oilers with reservoir. This simple device can be rigged up by your pipe fitter so as to automatically lubricate all of your table roll or dryer bearings with one reservoir. If a more copious oil flow is desired the piping can be so raised that the ends of the wicks in contact with the journals will be lower than the ends immersed in the vertical oil pipes. This arrangement produces syphonic as well as capillary action; but during prolonged shut-downs, if a continued flow is not desired, the reservoir and piping can be drained by means of a plug provided for the purpose.

spots in the roll itself due to the friction of the wire rubbing against it. This not only causes expensive table roll replacements but very seriously injures the quality of the paper at its most formative stage, interfering with uniformity; and last but not least rubs and wears out the expensive Fourdrinier wire. Furthermore, as the drive of the wet end of the machine is ordinarily through the lower couch roll, any drag on the bearings of the table rolls produces an uneven pull on the wire. This hastens an early replacement of the wire both from wear and from twisting it out of shape.

An automatic wick feed and reservoir oiling device to efficiently solve this problem is illustrated in Fig. 11, this eliminates the uncertainty of the human element and in some mills has completely eliminated the above mentioned troubles and requires attention only during the shutdown on Sundays.

Another advantage of this system is that the flow of oil can be easily regulated according to the size of wick employed.

In such an oiling device the same oils should be used as recommended above, paying particular attention that it is not too heavy to work properly and that it will not gum and clog the wicks.

Many new machines are equipped with ball-bearings. If the bearing cases are oil tight an oil of the highest quality and viscosity about 200 seconds should be used. Otherwise a liquid grease should be used taking care that it is neutral—the presence of a fatty acid tends to remove the polish of ball bearings and once the polish begins to go the days of the ball bearings are numbered.

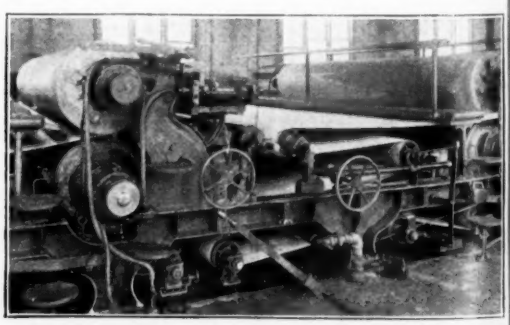
Couch Rolls

The wire carrying the web of paper after leaving the suction boxes passes between the couch rolls which squeeze out more water. In usual installations the lower roll is made of brass highly polished, and serves also to return the Fourdrinier wire, which winds down around the roll and travels back over the return rolls to its starting point at the flow box where it winds up over the breast roll and thus on to the table rolls again. The bottom couch roll is connected with a clutch to a driving cone and serves to drive the entire wet end of the Fourdrinier machine. The top couch roll, also of brass, is covered with a seamless woolen jacket and considerable pressure is exerted on top of the roll by means of levers and weights which bear down on the upper halves of the top couch roll bearings. Scientific lubrication of the couch roll bearings is exceedingly important.

Press Rolls

To many, the next phase of the paper machine is the most marvelous. After coming through the couch rolls, the now mushy paper web (which five seconds before was in the form of a thin watery mixture) has strength enough to stretch across *without support* a considerable gap of several inches to an endless woolen felt which carries it between the press rolls. The secret of this is that the pull on the paper web exerted by the press rolls is continuous and even, and the web is rapidly moving so that it gets no chance to tear.

Some machines have two and others three or more sets of press rolls, the drive being through the lower roll. These rolls are very heavy and in addition the top roll is connected on each journal with compound levers to



Courtesy of Beloit Iron Works.

Fig. 12.—Close up of Press rolls, note water cooling hose.

which heavy weights are attached, with the result that when the paper leaves the third press rolls it is as much as 35% dry. Due to the great pressure on these bearings, they

are often water cooled and usually provided with an automatic oiling device.

Smoothing Press Rolls

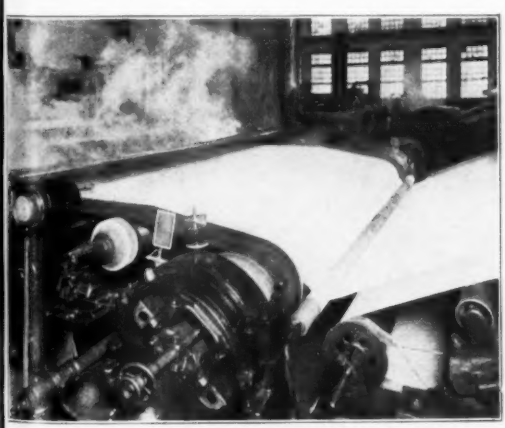
The smoothing presses are placed on many modern machines between the press rolls, and the dryers. They serve not to squeeze out water but to smooth and flatten the sheet and to remove wire and felt marks which can be removed while the paper is wet much better than in the calenders after it is dry. These bearings are usually automatically oiled.

Press Felt Rolls

These rolls support the wet felt and their bearings operate under no great pressures or temperatures, but are often of the open upper half type and are subjected to water. Wick oilers can be adapted to the bearings if equipped with a top cap and provided such installation does not interfere with changing and washing of the felts.

Suction Couch and Press Rolls

In many of the higher speed machines in which it is necessary to accelerate the removal of water a lower couch or press roll is often substituted by a large suction roll and serves the double purpose in the case of suction press for squeezing out water and further removal by suction. The suction roll has a perforated shell and contains within it a stationary suction chamber set flush longitudinally with the top inner wall of the cylindrical roll. This is connected to a very powerful rotary vacuum pump. Often both



Courtesy of The Champion Coated Paper Co.
Fig. 13.—A Suction Couch Roll.

the couch and first press are equipped with suction rolls. In the case of a suction couch installation, the top couch roll is eliminated. The bearing of the suction roll is often not on journals but on the circumference of the cylinder ends. It is a chain roller bearing type usually from 36″ to 54″ in diameter and generally provided with an oil bath, often with an auxiliary oil sight feed bottle on top of the bearing.

Lubrication

When the couch, press, and press felt roll bearings are close fitting and lubricated by automatic oiling devices, if protected from water, an oil of about 500 seconds should be used. If partially protected, an oil of from 650 to 700 seconds and compounded with a fixed oil to meet water conditions is required.

If the bearings are worn or loose or if they are hand oiled and protected from water a viscosity of from 650-700 seconds should be used; to be on the safe side it should be compounded to meet water conditions.* If the bearing is partially protected it would be desirable to use a light bodied steam cylinder oil,* such as is used in the power plant. For ring or wick oilers the viscosity should not be in excess of 100 sec. at 210° F.

If oil is fed through the top bearing cap, care should be taken that the upper half is properly grooved so as to admit oil to the lower half on account of the pressure on the top half of couch roll bearings.

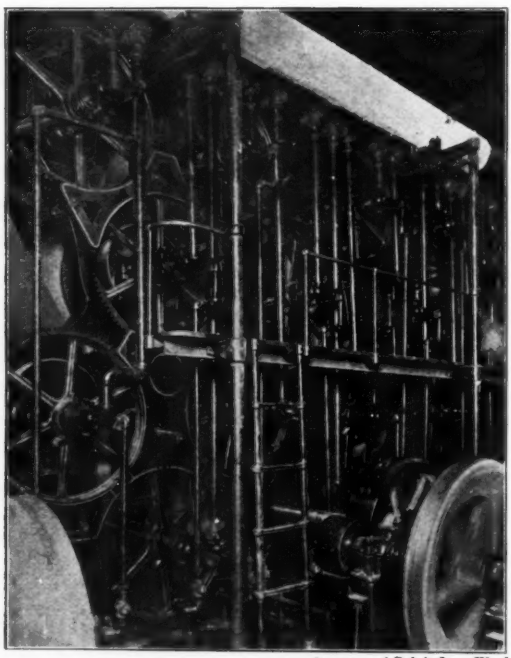
Such plain bearings as are lubricated by grease cups require a medium bodied grease capable of emulsifying with water to resist being washed away. The same grease should be applied to any open half bearings or plain bearings provided with a grease pocket, however in the latter case when possible it is desirable to install wick oilers.

CYLINDER MACHINE—WET END

The cylinder machine differs from a Fourdrinier machine in that while they both use a wire mesh to drain water from the pulp web, in the former the wire is stretched on a cylindrical framework which rotates in a vat of paper stock. As the hollow cylinder mould revolves, the fluid stock attempts to flow through the wire mesh into the cylinder leaving a deposit of fibres on the outer surface of the screen. The drained water within the cylinder flows away through the end of the cylinder to a "Save-all." The difference in level between the water inside the cylinder and the paper stock in the vat exerts sufficient suction to build up a considerable web or film of fibres on the surface of the cylinder. The web is picked up on an endless woolen blanket, or "bottom wet felt" which moves in the same direction as the surface of the cylinder

*Chain oiled bearings should be lubricated with a straight mineral oil.

and which is squeezed in close contact to it by a couch roll revolving in opposite direction to and on top of the cylinder. The drive of the cylinder machine is sometimes through the couch roll under which the "lower" felt with its paper web is carried on to another couch roll on top of another cylinder where an additional layer or lamination is squeezed into contact with the first, and so on to a series of other cylinder moulds up to a maximum of eight, or until enough layers of paper web are laminated together to give a paper board of the desired thickness.



Courtesy of Beloit Iron Works.

Fig. 14.—View of Back Side of Stack of dryers. Note steam joints and gearing.

In some cylinder machines the felt carrying the paper board is led up over a "felt drum roll" instead of over the last couch roll. The wet paper board supported by the bottom felt is then met by the top felt, and between the felts, passes through "making rolls," small "squeeze" and secondary press rolls, to suction boxes or suction rolls and finally to a series of press and dryer rolls similar to those of the Fourdrinier machine.

In most cylinder machines the drive is through the lower first press roll, though auxiliary drive is often applied to other rolls of the wet end.

There are numerous variations to the above described machine but so far as lubrication is concerned they offer no problems not met with in the above or in fact in the Fourdrinier Machine.

Lubrication

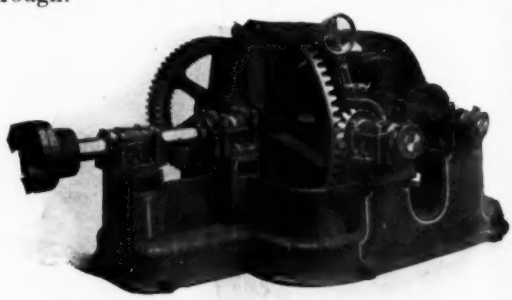
Practically all of the bearings on the wet end of a cylinder mould machine are water splashed and require a lubricant specially compounded to combat water conditions; when oil lubricated, the viscosity should be about 700 seconds and when grease lubricated a medium consistency should be used. Ball and roller bearings are becoming common on the cylinder moulds; for which a light or medium bodied oil may be used if the bearing case is oil tight otherwise a high quality liquid grease is required.

FOURDRINIER AND CYLINDER MACHINES—DRY END

When the sheet of paper leaves the press rolls it still contains 60% water and after weaving over and under the long series of "dryers" it emerges almost air dry.

Dryers

The dryers are a series of hollow cast iron cylinders, heated internally with steam, of which there may be as many as 100 on a large cylinder board machine. In all except some cases of board manufacture, the paper is transferred from the press felts to dryer felts for support. The dryer rolls are geared together so that they will operate synchronously and are driven by several drive stands or geared pedestals though in some recent installations individual electric motors are spaced at intervals. Dryers average from 3 to 6 feet in diameter and weigh up to 4½ tons, though the Yankee Fourdrinier Machine is equipped with one large dryer from 10 to 12 feet in diameter against which a series of press rolls runs. This gives a shiny surface to one side of the paper leaving the reverse somewhat rough.



Courtesy of Beloit Iron Works.

Fig. 15.—Geared pedestal used to drive the paper machine.

Steam Joints

The bearings on the back side of the dryers are hollow and equipped with steam joints for introduction of the steam required in heating the cylinders.

Felt Dryers

As the felt passes back from the last to the first dryer it is often dried on small dryer cylinders known as felt dryers. They are rotated usually only by the friction of the belt and are frequently mounted in roller bearings.

Dryer Felt Rolls

The felt is supported on the return trip from last to first dryers on dryer felt rolls which average from 6 to 12 inches in diameter. They are usually equipped with plain hand lubricated bearings, though ring oiled or ball bearings are used on many recent designs.

Lubrication

Dryer bearings offer one of the most difficult lubrication problems in the mill due to the high temperatures and pressures though the speed is low. The bearings on the back or steam side are inaccessible due to the driving gears, therefore some form of automatic lubrication is a necessity. When the bearings are plain and provided with a grease pocket or a recess for oil soaked waste it is most advisable to install wick feed oilers, preferably of a combination of wick and pad type, the pad end of the wick lower than the end immersed in the oil reservoir to take advantage of syphonic as well as capillary action. Neglect of these bearings soon causes the dryers to sag down at the back, and if allowed to continue unnecessarily high repair costs may result as well as shut down and "broke" expenses. The steam joint can very advantageously be equipped with wick oilers, automatically lubricating them for a period at least from Sunday to Sunday.

Even if the bearings are ring or collar oiled the uncertainty of the human element can be eliminated and better lubrication with resultant economies can be secured by installing the simple string of pipe and reservoir wick oilers as described for "table rolls," see Fig. 11.

One progressive mill has developed a successful set of dryers with ball bearings throughout.

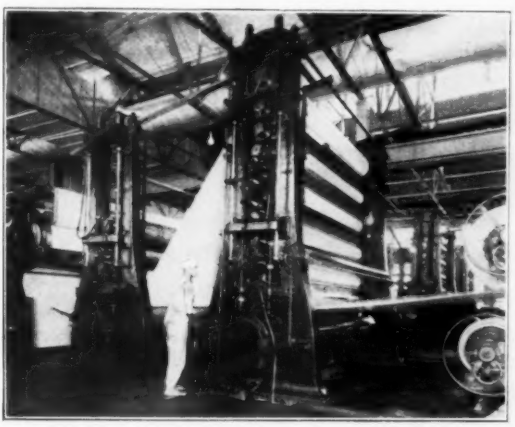
Many new installations are lubricated by means of ring or collar oilers in conjunction with continuous oil stream and filtering systems. This not only keeps the oil clean and fresh and *cool* but also provides a guarantee of sure supply of oil even if the system should break down owing to the fact that the bearing housings act as small reservoirs with *oil bath* sufficient for several hours.

In general it is desirable to use an oil of body high enough to withstand the high pressures and capable of being easily spread over the bearing surface and yet not be vaporized when exposed as a thin film on the journal. Even on close fitting bearings equipped with automatic oiling devices the oil should not be less than 60 seconds viscosity Saybolt at 210° F. And on worn or loose bearings, automatically lubricated, or hand oiled bearings a viscosity of about 170 seconds at 210° F. is recommended, except when lubricated with wick or ring oilers when a maximum viscosity should be 75 to 100 seconds at 210° F.

In order not to attempt to stock too many grades of oil in your mill, the steam cylinder oil in use in the power house will serve admirably for the *steam joints*, though if lubricated with wick oilers it is preferable not to use a cylinder oil higher than 100 seconds viscosity at 210° F.

When dryer bearings are to be lubricated with grease a special high melting point product should be used.

Dryer gears, and geared pedestals should be lubricated with a straight mineral adhesive oil of about 1000 seconds viscosity at 210° F. applied hot to the gears with a brush. GREAT CARE should be taken that this lubricant is not applied in excess, otherwise it will thin out and run down to felts and paper.



Courtesy of The Champion Coated Paper Co.

Fig. 16.—A Calender Stack accomplishes the final operation of the work of the paper machine.

MACHINE CALENDERS

The paper coming from the dryers is next run through a calender stack which irons or smooths out and polishes the paper under high pressures. The bottom calender roll may be 25 inches in diameter and weigh several tons—there are from seven to eleven in a vertical stack. Calender bearings are so difficult to lubricate that new designs are usually provided with continuous oil stream

lubrication which tends to keep the bearings cool. If the bearings are hand oiled considerable economy can be effected by installing wick or continuous stream systems.

Lubrication

If the bearings are close fitting and lubricated by wick, drop feed, circulating oil systems or in the case of the bottom roll by ring or collar oilers, an oil of 60 to 65 seconds viscosity at 210° F. should be used. If worn or loose or hand oiled, a viscosity of 85-100 seconds viscosity at 210° F. is required, though bottom roll bearings if ring or collar oiled and worn or loose, can be successfully lubricated with an oil of 65 to 75 seconds viscosity at 210° F.

REELS AND WINDERS

There are two types of reels, revolving and stack; the former consists of a set of reels arranged in the form of a cylinder. The framework carrying the reels revolves so that at the time one reel is filled another is ready to take its place, and similarly by the time one reel is almost unwound another is ready to go into position for unwinding. The stack reels are placed one on top of another in a vertical frame, they are driven with a clutch while the revolving reels are driven by gears.

Lubrication

The bearings while usually plain and hand oiled or grease packed offer no lubrication problems as pressures and speeds are low. If the bearings are close fitting an oil of 300 seconds viscosity should be used, and if worn or loose from 400 to 500 seconds is satisfactory. A medium consistency grease should be used.

PAPER FINISHING

SUPER CALENDERS—PLATING AND FRICTION CALENDERS

It is sometimes desired to give a very high finish to paper and somewhat heavier calenders run at high speed are required. It is a common practice to run the calenders without paper and in close contact until hot before introducing the paper. Some of this heat is conducted to the bearings. The problem therefore is a little more severe than with machine calenders.

Lubrication

The same recommendations apply as for machine calenders. The driving gears should be lubricated with an adhesive lubricant of 1000 seconds viscosity at 210° F.

MISCELLANEOUS PAPER FINISHING MACHINES

In the finishing room a number of machines are used to automatically cut, fold, pack and rewind paper for the market. The lubrication of these machines offers no serious problems not met elsewhere in the mill.

Lubrication

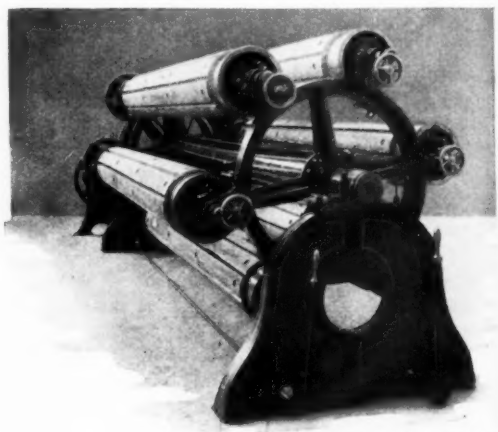
For close fitting bearings automatically lubricated an oil of 200 seconds will serve. If the bearings are worn or loose or plain and hand oiled a viscosity of 400–500 seconds is required. For grease cups and bearings provided with grease pockets or open half grease lubricated bearings a medium consistency grease should be used.

PAPER CONVERSION

A large number of automatic machines is used for converting paper and board into useful articles of commerce such as tar and waxed paper, corrugated boxboard, paper bags and boxes, envelopes, tubes and paper cups.

Lubrication

These machines can all be lubricated with oils ranging from 200 to 500 seconds viscosity, and medium grease as recommended for paper finishing machinery.



Courtesy of Beloit Iron Works.

Fig. 17—Typical "Revolving" Reel.

CONCLUSION

While in order to treat this subject in a complete manner, it has been necessary to recommend a large variety of lubricants, in actual practice only a few grades will be required. In many cases the same lubricants can be used to advantage in the power plant. Lubrication of power plants was discussed in LUBRICATION for November 1923. Shafting etc., offers no problems not met in the above machines. In any event it would be desirable to avail yourself of the services of the skilled technical staff of a reliable oil company whose aim is to furnish "lubrication," not necessarily just oil.

Printed in U. S. A. by
EDGAR C. RUWE CO., INC.
47 West Street, N. Y. C.